Altered Nuclear Transfer: A Philosophical Critique

• **Adrian J. Walker** •

"ANT is technically and morally indistinguishable from human cloning."

Introduction

The proposal of Altered Nuclear Transfer (ANT) emerges against the background of the controversy surrounding President George W. Bush's 2002 decision to withhold federal funding for research on embryonic stem cells (ESC) requiring the creation of new cell lines. The *enjeu* of the controversy will surely be familiar to most readers: on the one hand are those who oppose any embryonic stem cell research because the procurement of embryonic stem cells requires feticide; on the other hand are those who insist that the potential biomedical benefits of embryonic stem cell research outweigh any moral scruples based on the supposed humanity of the pre-implantation embryos from which embryonic stem cells are extracted. Since neither side in the debate seems willing to budge to accommodate the other, proponents of ANT suggest that the only way to move beyond the resulting deadlock is to develop "a 'third option,' a technological solution to our moral impasse"[1]: to develop, that is, efficient techniques for procuring human embryonic stem cells that bypass the creation and destruction of human embryos altogether, and so are acceptable both to the scientific

[1]William B. Hurlbut, "Altered Nuclear Transfer as a Morally Acceptable Means for the Procurement of Human Embryonic Stem Cells," paper presented to the President's Council on Bioethics, 3 December 2004, 1.

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community for their efficiency and to the pro-life community for their providing an alternative to feticide. Hence the proposal of ANT, whose fundamental idea is to modify existing techniques of somatic cell nuclear transfer (SCNT), so as to produce, with the aid of genetic engineering, limited biological entities that yield human embryonic stem cells, but are never themselves human embryos. ANT would thus

> use the techniques of Nuclear Transfer, but with the intentional alteration of the nucleus *before* transfer, to construct a biological entity that, by design and from its very beginning, lacks the attributes and capacities of the human embryo. Studies with mice already provide evidence that this *Altered* Nuclear Transfer may be able to generate functional ES cells from a system that is not an embryo, but possesses the limited organic potential of a tissue or cell culture.[2]

Proponents of ANT insist on the preemptive nature of the proposed procedure. ANT, they assure us, would not bring in to being a human embryo and then, after it already exists, destroy it for the purposes of obtaining embryonic stem cells. On the contrary, ANT would perform its genetic engineering so to say *ante ovum*—for example, by altering the donor cell nucleus before the actual somatic cell transfer—to ensure that the new entity would never have the genetic platform necessary to support the features it would have to have to count as a human embryo, or even as an organism or living being:

> The crucial principle of any technical variation of ANT . . . must be the *preemptive* nature of the intervention. This process *does not* involve the creation of an embryo that is then altered to transform it into a non-embryonic entity. Rather, the proposed genetic alteration is accomplished *ab initio*, the entity is *brought into existence* with a genetic structure insufficient to generate a human embryo. From the beginning and at every point along its development it cannot be designated a living being. If such a limited biological entity were accorded a certain cautionary respect—as with all human tissues—this project would not compromise any fundamental moral principles. Moreover, such techniques could be developed using animal models, then confidently extended to

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[2]Ibid., 8f.

> work with human cells without engaging in research that involves the destruction of human embryos.[3]

Proponents of ANT claim that there is a natural precedent or analogue for the proposed procedure. It is well known that many spontaneous abortions involve teratomas, which are essentially benign tumors that result from abnormal genomic imprinting. "But," proponents of ANT argue, "[s]ome of these aberrant products of fertilization, which lack the qualities and characteristics of an organism, appear to be capable of generating ES cells or their functional equivalent."[4] For example, "[w]hen an egg is activated without a sperm, the trophectoderm and its lineages fail to develop properly,"[5] but the abnormal conceptus will contain the inner cell mass from which embryonic stem cells, or their "functional equivalents," can be drawn. ANT therefore "proposes the artificial construction of a cellular system mimicking these natural examples, a system that lacks the essential elements for embryological development but contains a partial developmental potential capable of generating embryonic stem cells."[6]

ANT seeks to offer a technological solution to our moral impasse, then, by creating sub-organismic entities from which functional human embryonic stem cells could be obtained, but whose sub-organismic status would obviate any moral concerns about feticide. Since ANT aims to bypass our moral deadlock technologically, it leaves untouched the question of principle—may we or may we not destroy pre-implantation embryos for embryonic stem cell research? Nevertheless, its acceptability to those who think that we may not destroy pre-implantation embryos for biomedical research or for any other reason (on the grounds that they are nascent human beings), depends entirely on the truth of the claim that ANT would create not human embryos, but something else: sub-organismic biological entities akin to tissues or to teratomas. My purpose in the following pages is to argue that this factual claim about what ANT would do is false. Despite its proponents' best intentions, ANT, I hope to show, is technically

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[3]Ibid., 12; emphasis in the original.

[4]Ibid., 5.

[5]Ibid., 6.

[6]Ibid., 4.

and morally indistinguishable from human cloning. ANT is the creation and destruction of a human organism after all, and so is no more morally acceptable a method for procuring human embryonic stem cells than the more obviously feticidal ones currently in use.

The proposal of ANT is designed to accommodate the moral convictions of those who believe that human life begins at conception.[7] Accordingly, I will not be arguing directly for the reasonableness of the commitment to protecting pre-implantation embryos. I will rather take it for granted, and will concentrate instead on vitiating ANT proponents' factual claim that the product of the proposed procedure, so far from being an embryo, would not even establish the minimum level of inner coherence an entity needs in order to count as a complete living being, and not simply as a tissue or a teratoma. Given that ANT is supposed to respect the beliefs of those who hold that a human life is present from conception, the demonstration of the falsity of this factual claim will be sufficient to show that the procedure is no more morally acceptable than the obviously feticidal techniques currently employed to obtain human embryonic stem cells. Note that, because proponents of ANT set the bar at organismal unity, in what follows I will mostly, though not exclusively, be using the language of "organism," and will be trying to show that ANT would not create sub-organismic, tissue- or teratoma-like entities, but human organisms pre-programmed to be unable to maintain themselves as such beyond the stage of their development when embryonic stem cells can be extracted from them.

I. The Limits of Experimentation

That having been said, someone might reproach me, a confessed scientific layman, for a certain presumption in pronouncing a decided "No" upon a claim being advanced by reputable scientists. If qualified experts are describing ANT as a way of procuring human embryonic stem cells without creating embryonic human organisms, in the name of what could a non-expert

[7]Although one need not hold this conviction oneself to embrace ANT, it is no accident that the architects of the proposal, along with most of those who have publicly endorsed it, do believe that a human life, worthy of respect and legal protection, is present from the moment of conception.

challenge the accuracy of this description, if not of his a priori decrees about what science can and cannot do? Would it not be more prudent for him to hold his peace at least until experimentation—and, for the time being, only animal experimentation is being proposed—has determined the status of the new entity the procedure would produce?

In response, I propose a counter-question: how is experimentation supposed to settle this question? Certainly not by its empirical "success," because all such "success" can show is that it is technically feasible to use some form of modified SCNT to procure human embryonic stem cells. What it cannot do, however, is decide precisely the question at issue in the debate: is the product of this modified SCNT procedure a human organism—or is it not?

Any attempt to address the question of the ontological status of the ANT product necessarily brings into play a trans-experimental criterion. Such a criterion, moreover, inevitably both judges the relevant empirical data to mean that a human organism is or is not present and guides the selection of which data are relevant to deciding the question in the first place. By the same token, it would be naive or disingenuous to defend ANT from the kind of critique I will be laying out here on the grounds that I am presuming to pre-judge the scientific evidence on the basis of some trans-empirical philosophical claim. The fact of the matter is that both I and the proponents of ANT are pre-judging the scientific evidence on the basis of what is, in the loose sense at least, a philosophical criterion. The question at issue between us, then, is not whether philosophical reflection should be admitted into the discussion, but, given the already philosophical character of the discussion, which of the respective trans-empirical criteria for judging organismic status—mine or theirs—is true?

As it turns out, the proposal of ANT explicitly assumes a certain "mereology," that is, a certain (in the loose sense at least) philosophy of the relationship between parts and wholes.[8] Although

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[8]Proponents of ANT appeal, in fact, to the emerging science of "systems biology," which highlights how the living organism is a dynamic system of interrelated parts, all of which need to be present all at once, and in interdependence, in order for the organism even to be the organism it is. On the basis of this new view of what might be called the coordinated all-at-onceness of living organisms' essential parts, proponents of ANT go on to argue that the absence or alteration of certain genetic factors can prevent this coordinated all-at-onceness from

proponents of ANT explicitly disavow old-fashioned mechanism, this mereology, I hope to show, is subtly, but decisively, mechanistic: the coordinated all-at-onceness of the organism, they seem to hold, is just the sum of its interlocking partial subsystems—so that the "whole is the sum of its parts," a classic mechanistic maneuver.[9] Indeed, the *telos* of my argument is to demonstrate that it is because of this subtle mechanism that ANT's proponents are unable to see that and how the procedure would create human organisms after all.

Before arriving at this Q.E.D. towards the end of the essay, though, I will spend many of the following pages arguing that, even independently of the philosophical inadequacy of the criterion for organism underlying it, ANT also contains a conceptual flaw, an inner contradiction, that becomes apparent, not in the light of some a priori criterion, but when we attend to the conceptual structure of the proposal on its own terms. I emphasize once again that exposure of this contradiction will not take the form of an a priori

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emerging in the course of (what would otherwise be) embryogenesis. By identifying these genetic factors, and artificially removing or altering them *ante ovum*, the proposal goes, ANT could therefore ensure that its product would never be able to have the genetic platform for the realization of organismal being. It could ensure, in other words, that no human organism would occur, and that what arose in its place would be simply a partial system, having a partial developmental trajectory, from which functional human embryonic stem cells could be extracted without raising any moral objections: "Beyond highlighting our strange and challenging new powers over developmental biology, the parthenogenetic mouse points to another level of advance in our understanding: our new appreciation of systems biology, in which we see how even a small change of one gene can affect the entire balance of an enormous network of biochemical processes within the cell. Systems biology offers us the view of an organism as a living whole, a dynamic network of interdependent and integrated parts. If severed from the whole, these partial subsystems may temporarily proceed forward in development, but without the larger environment of their organismal system, they will become merely disorganized cellular growth. ANT proposes that small (but precisely selected) genetic alterations will allow us to harness these subsystems of partial development, apart from their full natural organismal context, in order to produce ES cells" (Hurlbut, "Altered Nuclear Transfer," 7f).

[9]Again, this is not to say that the proponents of ANT are avowed mechanists. On the contrary, their emphasis on the coordinated systematicity of living systems is meant to be anti-mechanist. What I aim to show is that, despite this intention, the claim that ANT can procure human embryonic stem cells without creating an embryonic human organism in the process could be true only if something like mechanism, albeit in a more refined form, were true.

consideration about what science can and cannot do by way of procuring functional, human embryonic stem cells without producing embryonic human organisms in the process. Rather, it will take the form of a consideration of what the conceptual parameters of ANT require, a priori, of any conceivable version of it. Only then will I undertake to demonstrate that ANT's proponents could miss, or minimize the importance of, this flaw only on the basis of an inadequate, still too mechanistic philosophy of parts and wholes.

My argument in what follows proceeds in three steps. In Section Two I will expand what I have said just now about the contradictory conceptual structure of ANT. The general strategy of ANT, which uses human SCNT to get human embryonic stem cells, is incompatible, I hope to show, with the claim that ANT avoids creating a new human organism.[10] Section Two thus concludes with the main thesis of the essay: given the falsity of this latter claim, a falsity built into the very conceptual structure of ANT itself, the procedure is technically and morally indistinguishable from human cloning. Since the proposal of ANT banks substantially on the power of genetic engineering to prevent its product from ever being a human organism—and so to keep the procedure clearly distinct from human cloning—I will go on to argue in Section Three that the kind of genetic engineering needed to prevent the product of ANT from being a human organism (which, I will show, would have to involve an essential modification of the genome of the donor cell), even if it were technically possible, would conflict with ANT's stated goal of obtaining functional human embryonic stem cells. Section Four will then explore the subtly mechanistic mereology underlying the inflated

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[10]Somatic cell nuclear transfer is a form of cloning. Obviously, proponents of ANT insist that they are not engaging in cloning/somatic cell nuclear transfer. What they do claim, though, is that ANT is an altered form of somatic cell nuclear transfer, and that the alteration is sufficient to keep it from being cloning. The idea is that genetic engineering, performed before the actual nuclear transfer, makes all the difference between ANT and cloning. Thus, when I say in what follows that ANT uses or relies on somatic cell nuclear transfer, I am assuming, even when I do not say so, that ANT also intends to *alter it, through genetic engineering, to change its character as cloning*. Taking this for granted, I will nonetheless argue that the genetic engineering ANT involves cannot fundamentally alter the character of the underlying technique of somatic cell nuclear transfer—and so cannot really be anything but cloning (cannot by reason of the conceptual structure of ANT itself).

hopes the proposal of ANT pins on the supposed power of genetic engineering to reshape human reproduction and development. Finally, this exploration will suggest for the Conclusion some remarks about the moral problem with the proposal of ANT, which is not just that the procedure would clone for scientific research, but also that, contrary to the best intentions of its architects, it participates in a typically modern attempt to break down the distinction between the artificial and the natural, which implies that there is no ethical order built into the heart of physical nature, and that whatever can be done technically may be done morally.

II. A Conceptual Fly in the Ointment

Briefly put, ANT's conceptual fly in the ointment is as follows.[11] ANT would use nuclear transfer (in some modified form) to initiate the process leading to the procurement of embryonic stem cells. Now, for these embryonic stem cells to be functional and human—if ANT is to do its job, in other words—then they will have to have a reasonably complete human genome, by which I mean, here and throughout the essay, one containing, not only a full complement of 46 chromosomes, but one in which 23 of these are maternally derived and 23 paternally derived (even if at one or more removes). This means, in turn, that the original donor cell will have to have the same reasonably complete human genome, too. But SCNT using a reasonably genomically complete donor cell in this sense is . . . human cloning. If ANT thus turns out to be a

[11]Before going on, let me say a word about the purpose of this section of the essay. My aim in this section, once again, is to show that (and how) the concept of ANT is self-contradictory. My approach here is formal. That is, I do not elaborate or defend any substantive account of (human) organism. It is only in the following two sections—Sections Three and Four—that I do so. For the time being, I concentrate solely on the conceptual flaw in the idea of ANT itself, in order to make it crystal clear that my critique of ANT is not based on a priori considerations, but on the implications of the ANT proposal itself. I should say, though, that I will from time to time make certain claims about human organism in the present section. These claims, however, have an *ad hoc* character, because they are intended to say just enough to parry immediate objections. They are all relevant, and their import should be readily obvious. If, however, their relevance should seem doubtful, I beg the reader's indulgence: the doubt will be resolved in due course, when I take them up again more systematically in the following two sections of the paper.

form of human cloning "with a twist," as one newspaper account put it,[12] then the "twist"—the genetic engineering ANT would undertake—cannot be sufficient to revoke the organismic status of the new entity the procedure would produce. It can only superficially mask organismic identity, not suppress or eliminate it altogether.

In order to illustrate this conceptual flaw in the proposal of ANT, I briefly examine the main variant of the procedure that is currently on the table. In this scenario, scientists would silence the Cdx2 gene (or a gene with a similar function), which triggers the differentiation of the trophectoderm at the beginning of blastocyst formation. Silencing Cdx2 or a similar gene in humans would enable the new entity to become a blastocyst, and so to contain the inner cell mass from which embryonic stem cells are extracted, while ensuring that the new entity would lose the coordinated all-at-onceness of essential parts that, it is argued, is a necessary condition of its counting as a human organism. Silencing the gene would thus bring into being a limited "biological 'artifact'" that shared part of the developmental trajectory with a normal human embryo—just enough of it, in fact, to be able to provide embryonic stem cells—but would not count as a human organism, but as something akin to a tissue or to a teratoma:

> As well demonstrated in the work of Dr. Janet Rossant at Mt. Sinai Hospital in Canada, the gene Cdx2 is essential for embryogenesis. This gene is expressed immediately after compaction (around the 16-32 cell stage), and is crucial for the differentiation of the trophectoderm, the outer layer of cells that seals the embryo and controls the flow of water and ions to the inner cavity.
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> Although the trophectoderm cell lineage is the source of the extraembryonic membranes, it is properly considered an integral part of the embryo, as it plays a central part in the interactive cellular inductions that generate all subsequent embryonic development. Studies confirm that a functional trophectoderm is absolutely essential in embryogenesis. In experiments with mouse models, when Cdx2 is not expressed there is only a partial and

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[12]Gareth Cook, "New Technique Eyed in Stem-Cell Debate," *The Boston Globe*, 11/21/04; at:
http://www.boston.com/news/science/articles/2004/11/21/new_technique_eyed_in_stem_ cell_ debate.

> disorganized developmental process resulting in a visibly abnormal blastocyst. Nonetheless, there is the formation of an inner cell mass from which functional ES cells have been harvested, as reported in the May 2004 Proceedings of the National Academy of Sciences. For the purposes of ANT, Cdx2 might be deleted from the somatic cell nucleus prior to transfer. Once the partial ES cells have been generated, the gene could be re-installed to allow fully potent ES cells.
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> This technologically-created limited cellular subsystem, from which the ES cells could be obtained, would fail to establish even the most basic features of human organismal infrastructure. A deficiency at the first differentiation of cell type—the formation of the trophectoderm—means the absence of the most fundamental order. According to Dr. Maureen Condic, a developmental biologist from the University of Utah, "When [the] trophoblast does not form, subsequent development follows a chaotic pattern, suggesting that organismal development has not been 'disrupted' in the absence of [the] trophoblast, but rather that an organism never existed in the first place." The resulting cells would have no inherent principle of unity, no coherent drive in the direction of the mature human form, and no claim on the moral status due to a developing human life. Rather, such a partial, disorganized organic potential would more rightly be designated a biological "artifact"—a human creation for human ends. The fact that some part of such a constructed entity will carry a certain momentum of development is morally equivalent to the fact that we can grow skin in a tissue culture and may one day grow whole organs or limbs in isolation. Lacking crucial elements in its fundamental constitution, such an entity could never rise to the level of a living being.[13]

Let us analyze the argument for ANT-by-Cdx2-silencing (ANTcd) this passage lays out. Its unstated premise is the same mereological assumption that, as we have seen, undergirds the proposal of ANT as a whole, namely, that, in order to qualify as a living organism, a biological entity has to be able to maintain the coordinated all-at-onceness of its essential parts. In light of this premise, the argument then goes on to say that, by ensuring *ante ovum* that its product will eventually lose the ability to maintain the coordinated all-at-onceness of its essential parts on account of what might be called a "delayed structural collapse," ANT can legitimately claim to have created a "biological artifact" that never rises

[13]Hurlbut, "Altered Nuclear Transfer," 9f.

to the level of a living organism in the first place. Note the implication of the citation from Maureen Condic: the ANT-created artifact may superficially resemble a living organism for the first three or four days of its existence, but the genetically pre-programmed outcome of delayed structural collapse will reveal it to have been a sub-organismic, merely tissue-like biological construct all along.

The problem with this argument is that it is guilty of a *non sequitur*. Let us grant for the time being the criterion for organismic status it rests on: an entity has to be able to maintain the coordinated all-at-onceness of its essential parts in order to count as an organism.[14] Now, by this standard, it would follow that, once entity X fails to grow a trophectoderm, and so ceases to be able to maintain the coordinated all-at-onceness of its essential parts, it is no longer an organism. But from the fact that X can *no longer* maintain the coordinated all-at-onceness of its essential parts, it does not follow that it was not able to do so *up until that point*—and so to count, at least temporarily, as an organism by the very criterion of organismic status that ANT itself invokes.

Three pieces of evidence support the organismal status of the new entity, at least during the first three or four days of its existence. (1) First, the new entity would possess a full human genome having a full complement of chromosomes derived ultimately from the fusion of male and female gametes.[15] (2) Second, the new entity would be indistinguishable from a normal human zygote until the beginning of blastocyst formation (so for the first three or four days of its existence).[16] (3) Third, if the gene

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[14]Section Four will address the inadequacies of this criterion.

[15]Note that the Cdx2 (or a similar) gene would be silenced, and then "switched back on." But even if the gene were removed, and were removed prior to the SCNT, it is hard to see how this would be sufficient to keep the new entity from ever being an organism. It is much more plausible to say that it would be an organism with a severe defect that, once manifested, would prevent it from surviving any longer as an organism.

[16]Someone might object that, even if the new entity produced by ANT resembles a human zygote until reaching the blastocyst stage, this resemblance is no argument for its human status, because ANT would involve genetic engineering to ensure delayed structural collapse in the new entity. But this objection will be effective only if the objector is entitled to hold that genetically engineered delayed structural collapse is capable of altering the nature of anthropogenesis so radically as to create

were "switched back on" in time, the new organism could presumably complete the normal developmental path typical of embryonic human beings.

All ANTcd can legitimately claim to do, then, is destine its product *ante ovum* for delayed structural collapse. But delayed structural collapse is no grounds for asserting that the ANT product is never a human organism at all.[17] Indeed, whether or not delayed structural collapse occurs, and whether or not it is programmed *ante ovum* is irrelevant so long as there remains an essential genomic continuity between the donor cell used in ANTcd and the embryonic stem cells that the procedure derives from that cell. Let me be clear: I am not arguing that everything genomically human is *ipso facto* a human organism. I am simply pointing out that ANTcd is a form of SCNT, which means that the genome of the embryonic stem cells obtained at the end of the process is one and the same as the genome of the donor cell used at the beginning of the process. And not just any genome is at stake, but a reasonably complete human genome, otherwise there could be no question of ANTcd's getting functional human embryonic stem cells at all. But SCNT using a donor cell with a reasonably complete human genome is human cloning. ANTcd is indeed human cloning with a twist. This conclusion is confirmed by a recent scientific critique of the proposal of ANT:

> Second, in mice, *Cdx2* is required not only for trophectoderm formation but also for the subsequent development of a normal embryo. It is likely that human embryonic stem cells carrying a mutation in *Cdx2* will be restricted in their developmental capacity

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a new, non-human type of being. But this assumption is precisely what is at issue, and so cannot be invoked or relied on without question-begging.

[17]Note that the length of the delay in the delayed structural collapse is immaterial. What *is* material is rather the sequence: constitution of genomic identity—inner cell mass. So long as this sequence is in place, there is no essential difference between, say, ANTcd, in which the delayed structural collapse occurs after three days, and some hypothetical scenario in which the interval would be reduced seemingly to zero. Strictly speaking, of course, there must be some interval of time: delayed structural collapse must always be delayed at least long enough for the inner cell mass to form. Nor is it likely that any form of ANT will succeed in getting the inner cell mass in anything less than the three or four days expected in the case of ANTcd. To be able to pull this off would be nothing short of a miracle, at least given the limits of current technology, within which ANT is explicitly conceived.

> in ways that are impossible to predict but that will probably limit their usefulness in research and clinical applications. Hurlbut suggests that this problem could be circumvented by inactivating *Cdx2* reversibly, perhaps by RNA interference. This adds another layer of complexity and would require further time-consuming experiments. Even if these extra manipulations proved technically feasible, it is not clear that reversible inactivation of *Cdx2* is ethically distinct from destroying the embryo by the immunosurgical method that is routinely used to derive human embryonic stem cells.[18]

Now, proponents of ANT are quick to point out that ANT is first and foremost a conceptual approach, whereas ANTcd is just one possible concretization of this approach.[19] They thus have a ready response to my argument against ANTcd: even if ANTcd should turn out to be human cloning with a twist, might we not eventually be able to elaborate some other method of ANT that would not be? The answer to this question must be negative, however: any conceivable form of ANT will have a structure analogous to that of ANTcd and so will turn out to be human cloning with a twist. ANT, it should be obvious by now, is a form of SCNT aimed at procuring functional human embryonic stem cells. Now, in order for these embryonic stem cells to be both human and functional, they have to have a reasonably complete human genome. From where will they get this genome, however,

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[18]Douglas A. Melton, George Q. Daley, and Charles G. Jennings, "Altered Nuclear Transfer in Stem-Cell Research—A Flawed Proposal," *New England Journal of Medicine* 351, no. 27 (December 2004): 2791. It should be noted that Melton et al. do not object to the proposal of ANT on ethical grounds—they think the use of pre-implantation embryos to procure human embryonic stem cells to be morally justified—but on technical ones. Nevertheless, their objections bring to light the contradiction at the heart of the ANT proposal. For a critique of ANT, focusing particularly on ANTcd, by a geneticist and ethicist, see Roberto Colombo, "Altered Nuclear Transfer as an Alternative Way to Human Embryonic Stem Cells: Biological and Moral Notes," *Communio* 31, no. 4 (Winter 2004).

[19]"What is proposed here is a concept, an approach to a problem; the specific examples, which may or may not be morally acceptable or scientifically feasible, are offered only to make clear the larger concept, and as a starting point for discussion" (Hurlbut, "Altered Nuclear Transfer," 2); referring to ANTcd, the author says "[f]or the sake of specifics in this discussion, let me propose one particular example of how this could be accomplished. This may not be an acceptable ultimate solution, but it will allow us to consider the necessary criteria for scientific success and moral acceptability" (ibid., 9).

if not from the donor cell used in the SCNT? Notice the implication of this: ANT will involve SCNT using a donor cell containing a reasonably complete human genome. But SCNT using a donor cell containing a reasonably complete human genome, as we have already seen, is human cloning. Insofar as the concept of ANT both aims at functional human embryonic stem cells *and* uses human SCNT to accomplish that aim, it is in conflict with the claim that the procedure would not produce new human organisms—so much in conflict, in fact, that ANT, so long as it deploys the same basic technical strategy for the same basic purpose, always turns out to be a form of human cloning with a twist.

Significantly, the phenomenon of hydatidiform moles, invoked by proponents of ANT as an analogy to the product of ANT, actually confirms this analysis.[20] There are two kinds of hydatidiform moles: partial and complete. The partial hydatidiform mole—which, interestingly, tends not to appear in the proposals for ANT—is arguably just a severely defective human embryo.[21] As for complete hydatidiform moles, although some contend that they may have an initial organismic trajectory,[22] these androgenotes differ from the product of ANT in one significant way: they have 46 paternally-derived chromosomes and lack the chromosomes derived from the female, whereas the new entity generated by ANT would have a complete human genome consisting of a full complement of 46 chromosomes derived, ultimately, from a normal fusion of male and female gametes. Proponents of ANT sometimes appeal to another class of teratomas, namely parthenotes, which lack, not the maternally-derived, but the paternally-derived chromosomes. Here, too, the analogy to the ANT product fails, for similar reasons: the ANT product has a full complement of male- and female-derived chromosomes, whereas the parthenote has a full complement of chromosomes derived only from the female.[23] True,

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[20]This analogy is developed most fully in Nicanor Austriaco, O.P., "Teratomas as an ANT Standard," *National Catholic Bioethics Quarterly* 5, no. 1 (Spring 2005).

[21]Tadeusz Pacholczyk, "The Substantive Issues Raised by Altered Nuclear Transfer," *National Catholic Bioethics Quarterly* 5, no. 1 (Spring 2005): 18.

[22]Ibid.

[23]We read that "through intentional parthenogenetic activation of monkey eggs (which mimics teratoma formation), one private US company was able to coax them to a blastocyst-like stage and harvest ES cells" (Hurlbut, "Altered Nuclear

some parthenotes may, thanks to genetic engineering, be capable of normal development. It should be noted, however, that this genetic engineering merely artificially repairs a failed fertilization—and thus indirectly confirms the rule that, if a procedure obtains the same result artificially as fertilization does naturally (and so is parasitic on fertilization as a basic paradigm of genesis[24]), then it brings about a new human organism.[25] There thus remains a fundamental difference between teratomas and the product of ANT: the difference, that is, between an abnormal human genome marking the former as the product of a failed fertilization, and a normal human genome marking the latter as the product of an artificial substitute for fertilization. In a word, the teratoma analogy is something of a red herring that, if anything, corroborates my argument that, given the

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Transfer," 5). This may be true, but it suggests the following alternative: either it is possible to get functional human embryonic stem cells from parthenotes, in which case one wonders why ANT needs to use nuclear transfer with a donor cell having a complete human genome with male- and female-derived chromosomes; or it is not possible to get functional human embryonic stem cells from parthenotes without somehow making up for the missing male genetic components, in which case the analogy to parthenotes is a red herring, both because they are no longer authentic teratomas and because, for the same reason, they now carry the same conceptual flaw as ANT.

[24]This claim will be taken up in detail in Section Three.

[25]According to proponents of ANT, it may even be possible to produce a fully developed organism parthenogenetically, that is, in the absence of any paternally-derived chromosomes, simply by simulating the contribution that these chromosomes would normally make to embryogenesis. "Employing a form of Altered Nuclear Transfer, Japanese scientists produced a fully formed mouse using only female chromosomes, but with a single modification of an imprinted region to simulate the necessary male contribution. With this one change in genetic regulation directly affecting expression of just two genes, instead of disordered growth, normal offspring were produced. To everyone's amazement, this simple restoration of the male/female complementarity of gene expression resulted in changes in the downstream gene expression of over a thousand other genes" (Hurlbut, "Altered Nuclear Transfer," 7). In reality, this example of parthenogenesis actually corroborates my point. What it suggests, in fact, is that normal embryogenesis will not occur unless the missing male-derived chromosomes that make the difference between an egg cell and a fertilized egg cell are somehow made up for. On the other hand, the parthenogenesis example is something of a red herring, because, unlike parthenogenesis, ANTcd takes a somatic cell containing a complete genome containing all the requisite male-derived and female-derived chromosomes and alters it prior to the somatic cell nuclear transfer so that normal gene expression will not occur.

conceptual parameters of ANT, the entity it brings into being cannot be genomically human without also being organismically human. ANT remains cloning with a twist.

It goes without saying that the force of my critique of ANT depends on the truth of my assumption that the event that constitutes a new human genomic identity is also the event that constitutes a new human organism. Let me anticipate a possible objection, then. Proponents of ANT might accuse me of relying too exclusively on the genome to determine whether something is an organism or not. Organismal status, they might insist, depends not just on coming into being with the right genes from the start, but on having the right genes switch on and off at the right time in the developmental process. The trouble with this response, however, is that imprinting in embryogenesis normally *presupposes* the constitution of the complete human genome composed of 23 male-derived and 23 female-derived chromosomes. I am not suggesting, of course, that the genome is the sole relevant factor in anthropogenesis. I am merely pointing out that the constitution of a new human genome signals the absolute starting-point of the process of self-unfolding that only an already existing organism can perform, whereas every event coming after the constitution of the genome is better understood as a phase within that process. The constitution of the genome is the basic necessary condition for establishing organismic status, whereas the other factors are only necessary conditions for maintaining it once established.

Now, there are only two ways in which ANT could escape the conclusion that it is human cloning with a twist.[26]

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[26]But what if the goal of ANT were changed? Suppose, that is, that the goal were not to procure embryonic stem cells that contain a complete human genome, but that have at least some of the amazing properties that make human embryonic stem cells scientifically interesting, for example, plasticity, immortality, and the like. If that were our goal, why shouldn't it be possible, at least in theory, to create an entity capable of yielding cells that behaved like, or could be made to behave like, pluripotent stem cells, in the interesting respects, even if the cells themselves didn't contain a complete human genome? In other words, mightn't it be theoretically possible to identify which gene or genes are constitutive of the human organism, which gene or genes are constitutive of "stemcellness," and to set aside the former while keeping the latter—and so to obtain stem cells that have the relevant properties of stem cells, but not necessarily the full human genome to go with them? My response is twofold. On the one hand, in order for the scenario we are considering here to be morally acceptable, it would have to avoid *any sort of*

(1) First of all, ANT could try to bypass SCNT altogether, so that the suspicion of human cloning would never arise in the first place. The problem with this, of course, is that ANT has to rely on SCNT, if for no other reason than that we do not yet know how to get human embryonic stem cells without artificially inducing something enough like early embryonic development to yield the inner cell mass from which human embryonic stem cells can be obtained.[27] The proposal of ANT is predicated explicitly on existing technologies of nuclear transfer, which are to be used in an "altered" form until new techniques bypassing nuclear transfer altogether become available (for example, regression of adult stem cells to a pluripotent state).

(2) Because ANT has to rely on SCNT, then, the only strategy left for avoiding the objection of human cloning is that of attempting to change the essential structure of the genome of the donor cell from human to non-human. Now, such a change would have to be radical indeed—it would have to amount to nothing less than "metaphysical surgery" on the human DNA. It seems to me that, if the "whole is more than the sum of its parts," this kind of deep-going intervention is probably out of the question.[28] But there

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replication of normal fertilization. For example, if the parthenogenetic activation of a human egg were involved, any artificial simulation of male chromosomal imprinting would be enough to raise the specter of human cloning. On the other hand, suppose the scenario we are considering here involved SCNT, which in the normal situation is an artificial replication of the result of a prior fertilization-event. In that case, if the DNA of the donor cell nucleus were intact enough that, when inserted in the enucleated oocyte, it could still produce cells that had the same, or most of the same, properties of stem cells, even while lacking a complete human genome, we would have to treat the entity from which those cells were taken as at least presumptively a human organism.

[27]"Eventually we may understand the biochemical factors that can transform a somatic cell to a pluripotent state. But while the ultimate goal for the generation of ES cells is the direct nuclear reprogramming of an adult nucleus, it may be years before our scientific knowledge and control of cellular factors will make this approach feasible. More immediately, we may be able to use the techniques of Nuclear Transfer, but with the intentional alteration of the nucleus *before* transfer, to construct a biological entity that, by design and from its very beginning, lacks the attributes and capacities of a human embryo" (Hurlbut, "Altered Nuclear Transfer," 8).

[28]I have asserted that ANT cannot alter the genome of the donor cell radically enough to change it from human to non-human. The mere removal or suppression of genetic components is not the sort of thing that can change the essence of a

is a more immediate problem with this approach: even if it were possible, recourse to it would prevent ANT from being able to yield functional human embryonic stem cells, and so would ensure ANT's inability to deliver the product it has been designed to deliver. Given the conceptual parameters of ANT, then, whatever the procedure's proponents might claim about the scope of its *ante ovum* genetic engineering, it cannot really go deep enough to change the essential nature of the embryogenetic process, at the risk, once again, of violating those very parameters, in which alone ANT is ANT in the first place. The conceptual structure of ANT places its own a priori limit on what the genetic engineering it involves can be expected to do.[29] The task of the next section of the

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genome—otherwise a Turner's syndrome baby's lack of a chromosome would mean that it is not a human being, which is absurd. In order to change the essence of the genome, we would have to do more than suppress or remove genetic components; we would simultaneously have to create genomes for which it was natural never to have those components in the first place. We would have to do more than tinker with existing genomes, then. We would have to make new kinds of genomes to exist from scratch. In short, we would have to create *ex nihilo*. Since we do not know how to do that, and never will, it cannot be the case that ANT would literally change the essence of the donor cell genome, and so produce an entity that is essentially other than a human organism. All ANT can do, as I have said more than once, is bring into being an essentially human organism with a catastrophic genetic time bomb built into it.

An essence is like a "plan" whose realization requires certain parts. But the essence itself, precisely because it is a "plan" of this sort, is not composed of parts. This is why ANT's removal or suppression of genetic components is not sufficient to keep its product from being an essentially human organism. In order to change genomic essence, ANT would have to rewrite the very essential plan that requires the now suppressed parts in the first place—rewrite it in such a way that the absence of those parts is not a defect, but the natural condition of a brand new type of being. Doing this would mean (1) imagining a new kind of entity in all of its detail and (2) constructing a genome from the ground up to match. It is hard to see how such a project would require anything less than divine power to create out of nothing. Of course, proponents of ANT can reply that they do not intend to create a viable organism, but merely a genetically human, but sub-organismic entity. I acknowledge this intention. My point is simply that the only way actually to succeed in realizing it within the conceptual parameters of ANT would in fact be to create a new kind of being *ex nihilo*.

[29]It is most likely that the genetic manipulation would be some form of gene silencing. But even if it were to involve the outright removal of some gene or genes, this removal would have to leave the genome of the donor cell reasonably intact as an identifiably human genome, at the risk of frustrating the stated goal of ANT. Thus, so long as ANT pursues the goal of using human SCNT to procure

essay (Section Three) will be to substantiate this claim, making the case that ANT may look at first blush like the designing of a new type of genomically human, yet sub-organismic biological entity, but that it is really the cloning of human monsters.

III. Human Monsters

In order to assess the truth of ANT proponents' claims for the ability of genetic engineering to create a genomically human, but sub-organismic biological artifact, we need to enter into the discussion with an adequate criterion of organism ourselves. It seems to me that any such criterion has to take account of a fundamental distinction between manifesting organismal traits *de facto* and being an organism essentially. The manifestation of organismal traits, we could say, is a reliable index of the presence of an organism underlying those traits. Note, however, that the failure to manifest organismal traits is not necessarily a sign of the absence of the underlying organism. For example, the fact that a comatose person can no longer speak at will, at least for the time being, does not mean that he is no longer a human organism, who, *ceteris paribus*, ought to be able to speak at will, and, indeed, would be able to do so, if he were to awaken miraculously from his coma.[30] This

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human embryonic stem cells, and so long as this goal requires genomic continuity between those embryonic stem cells and the donor cell used in the SCNT, then ANT will necessarily be equivalent to human cloning.

[30]Let us say that I meet Mike for the first time on a foggy day in San Francisco, and that the fog is so thick that I see Mike only as a vague dark blur, and so cannot be sure whether he is a human organism or a mail box. Wanting to resolve my uncertainty, I call out to him, "Hello." If he answers back, "Hello, foggy day, isn't it?" I can take his reply as a sign that Mike is indeed a normal adult human organism, for human organisms can speak at will, and Mike is too big to be a parrot. But suppose that, after we have made each other's acquaintance, Mike is struck by a passing auto, and becomes comatose as the result of a severe blow to the head. He can now no longer speak at will, and it may even be the case that the coma has taken away his ability to imagine or to think. Does it follow from this that Mike is no longer a human being? Our ordinary intuitions suggest that the answer is negative. Most people would think, or at least spontaneously act as if, Mike's coma hadn't turned him into a monkey or a pig, but, rather, into a comatose human organism. It would seem, then, that the criterion of being able to talk at will is too narrow to match our ordinary intuitions, which tell us that even if Mike cannot talk

suggests that, if we want to be able to draw a principled distinction between an organism that is unable, on account of some defect or impediment, to manifest organismal traits and something that is not an organism at all, we need a criterion for organismal status that shifts its weight from the facticity of the here and now to a more essential reality that transcends the *hic et nunc*.

German philosopher Robert Spaemann gives us an important clue to finding such a criterion when he argues in his book *Personen* that the severely retarded still count as "persons," even though they cannot *de facto* perform "intentional acts," and that they do so simply because they are members of the human species.[31] Spaemann is aware of the danger of "speciesism," of course, and he does not intend to reduce personal being to human being.[32] His point, however, is not that every person is a human being, but that every human being is a person, because "[a] person is any animal *the physical make-up of whose species constitutes the species' typical members* as thinking intelligent beings, with reason and reflection, and *typically* enables them to consider themselves the same thinking things, in different times and places."[33] Let us call this "Spaemann's Principle."

Spaemann's Principle relies on the manifestation of an important organismal trait—the possession of a certain typical physical structure—as an index of organismal being. Nevertheless, Spaemann's Principle focuses not on the actual possession of that structure, but on the event by which a human organism normally acquires it: the event, that is, of anthropogenesis. By underscoring that a person's appropriate physical structure is owed him on account of his coming into being as a member of the human species, Spaemann's Principle is able to avoid the suggestion that, if he should fail to have the appropriate physical structure with 100 percent normality, he is not a human organism. Or, to be more precise: Spaemann's Principle implies that, even if X is a conceptus

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at will *hic et nunc*, he is still a human organism, who, all things being equal, should be able to talk at will.

[31]Robert Spaemann, *Personen. Versuch über den Unterschied zwischen 'etwas' und 'jemand'* (Stuttgart: Klett-Cotta Verlag, 1996), 259; 264.

[32]See, for example, ibid., 195f.

[33]David Wiggins, *Sameness and Substance* (Oxford: Oxford University Press, 1980), 188; cited in Spaemann, *Personen*, 264, note 6.

that comes into being with massive structural defects that destine him to die within a few seconds, we can still say that it was in X's natural teleology to be a human organism—so long as X in fact comes into being as a member of the human species.

Now, fertilization is the event in which one comes to be as a member of the human species for the first time.[34] Relying on Spaemann's Principle, then, we can formulate the sought-for criterion of organismic status thus: all X needs to do to count as a human organism in the essential sense is to come into being through fertilization.[35] Notice, however, that fertilization is, or coincides with, the event in which a new human genome is

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[34]Fertilization, I would argue, is the crucial threshold: before fertilization, in fact, there can be none of the self-directed development typical of human beings; after fertilization, by contrast, every other event that might be adduced as a likely candidate for anthropogenesis can be much more plausibly interpreted as a new stage in a process of development that fertilization initiates. The only serious potential objection to this claim is based on the phenomenon of monozygotic twinning, which is often invoked to show that fertilization is not sufficient to bring an individual into being, but that we must wait until after implantation (at least) to be able to speak confidently of a new individual. The problem with this objection is that it overlooks a significant aspect of the phenomenon of monozygotic twinning: the zygote does not divide into two or more incomplete sections, but into two or more complete wholes. Mysteriously, in other words, one individual *becomes* two or more individuals. Now, these two or more individuals are more or less genetically identical to the individual who became them. Which suggests, in turn, that at no time in the process of monozygotic twinning are we dealing with anything less than an individual. This is corroborated by the fact that each of the two or more new individuals can say, truly, "I was that individual organism that underwent the division." For helpful discussion of the ontological status of monozygotic twins, to which the foregoing reflections are indebted, see Kevin L. Flannery, "Embryos, Active Potency, and Twinning," *Anthropotes. Rivista di studi sulla persona e la famiglia* 14, no. 2 (1998): 429–431.

[35]This becomes clear when we think of an embryo. As a three-day-old embryo, Mike cannot speak at will. But, we know that, given enough time, and in the absence of any defect or impediment, Mike *will* be able to speak at will. How do we know this? Because we already know, on grounds other than the *de facto* presence of certain features typical of mature human organisms, that Mike is a human organism, without having to wait to see whether or not that *de facto* presence will be realized. We know this for the simple reason that Mike has come into being as human organisms normally do, that is, through being conceived by a human mother and a human father. In order to decide whether or not Mike is a human organism, then, all we need to do is determine whether or not he has come into existence by fertilization.

constituted out of the right number of male-derived and female-derived chromosomes. By the same token, we can say that the event in which a new human genome is constituted is also the event in which a new human organism is constituted, and can sharpen our criterion thus: ascertaining whether X is a human organism is as simple as ascertaining whether X came into being with the constitution of a reasonably normal new human genome formed by the joining of the right number of male- and female-derived chromosomes.[36] Note, moreover, that this criterion will hold, not only if Mike results from a fertilization, but also if he results from an artificial equivalent, such as cloning.[37] This has implications for the question of ANT, as we are about to see.

Returning to ANT, then, we find that its proponents blur the fundamental distinction between manifesting organismal traits and being an organism. Consider, in fact, their claim that the procedure aims to produce an entity that comes into being already lacking the genetic platform on which to establish organismic status, and so failing *ab initio* to be an organism.[38] In reality, however, there

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[36]I hasten to add that, in formulating the criterion in this fashion, I am not discounting the importance of epigenetic factors in embryogenesis. Nor—more importantly—am I reducing the ontological identity of the human being to his or her genes. I quite agree with Richard Lewontin that, whether developmentally or ontologically, human identity is not "all in the genes." (See, *inter alia*, Richard C. Lewontin, *Biology as Ideology* [New York: Harper-Collins, 1991] especially Chapter Two, "All in the Genes?"). My point is simply that, in the normal case, the presence of a complete, new human genome with the right number of male- and female-derived chromosomes is the *first* sign of the presence of a new human organism whose genome it is. By the same token, the epigenetic aspects of embryogenesis and, indeed, everything else that happens after fertilization, are best understood as a phase or phases in the self-development of an already-existing human organism—whatever the precise relationship of these chronologically posterior aspects to the genome.

[37]Human cloning does not involve a new joining of male and female gametes, but it does artificially prolong, if you will, such a joining that has already occurred. Cloning cannot work, even in theory, unless it "copies" a full complement of 46 chromosomes that, ultimately, came from a fertilization. Cloning is not at all the production of a new *kind* of entity, but merely the attempt to replicate the result of a prior act of fertilization—the bringing into being of a human organism—while bypassing a new one.

[38]In focusing on ANT's reliance on what might be called the "genetic criterion" of organismic being, I am not implying that proponents of the proposal do not invoke other criteria as well. They do. We find them appealing, in fact, to the

are no good reasons for thinking that this entity differs essentially from the conceptus in our previous example, which has the proper number of male- and female-derived chromosomes, produced in the course of the sex act between a human male and a human female, but which happens to come into being with a genetic defect that dooms him to die in a few seconds.[39] The fact that the ANT

"mereological criterion" that a biological entity X counts as an organism if it can maintain the coordinated all-at-onceness—to recall the term introduced above—of its essential parts ("[t]his technologically-created limited cellular subsystem, from which the ES cells could be obtained, would fail to establish even the most basic features of human organismal infrastructure" [Hurlbut, "Altered Nuclear Transfer," 10]); and to the "teleological criterion" that insists on an organism's having the active potential for, the intrinsic drive to, organismal maturity ("[t]he resulting cells would have no inherent principle of unity, no coherent drive in the direction of the mature human form, and no claim on the moral status due to a developing human life" [Hurlbut, 10]). My point in singling out the genetic criterion is that it pertains to the very original constitution of the ANT product, so that the new entity's failure to meet the genetic criterion guarantees its failure to meet the mereological criterion and the teleological criterion as well. For the same reason, whether or not the new entity's failure to live up to the teleological and mereological criteria amounts to anything more than a defective manifestation of organismic traits, as proponents of ANT claim it does, depends on whether ANT's genetic engineering can be said truly to have prevented the new entity from being constituted as a human organism is. Thus, by showing that this cannot be the case—that, given the essential genomic continuity between donor cell and embryonic stem cells required by the conceptual parameters of ANT—I will also have shown that ANT does not effect the total absence of the genetic structure corresponding to human organismal being, but merely engineers severe defects in what is otherwise a human organism. That is, I will also have vitiated the mereological and teleological criteria, and sufficiently made my case that ANT clones human monsters.

[39]There is no question, of course, that, unless he can maintain the coordinated all-at-onceness of his essential parts, Mike cannot survive (for long) as a human organism. Nor is there any question that the removal of one or more of those essential parts can deprive Mike of his ability to maintain the coordinated all-at-onceness of the ensemble of them. Thus, if Mike's heart should suddenly stop, he would die, perhaps instantaneously. It does not follow from any of this, however, that Mike would not have been a human organism up until that point. Now, suppose that Mike were a clone, and that some evil genius had genetically altered the genome of the donor cell nucleus from which he was "begotten" to ensure that his heart would stop just when it did. Mike's mad creator could say, truly, that he had designed him to be unable to maintain normal heart function beyond, say, his thirty-sixth year. But, here again, it would not follow that he had designed Mike to be something other than a human organism. Now, suppose further that the damage the evil genius had programmed into Mike were much more extensive and had happened much earlier, not in the thirty-sixth year of Mike's existence, but on the

product starts out already lacking certain developmentally crucial genes *ab initio*, without which it is destined for delayed structural collapse, therefore guarantees only that it is a genetically defective human conceptus—only that it cannot survive as an organism, not that it was not in its natural teleology to be one.[40]

While the presence of the appropriate genetic structure is a reliable sign of the presence of an organism of the corresponding sort, the absence of this structure is not necessarily a sign that the corresponding organism is absent, too. To be sure, the absence of the appropriate genetic structure might mean that the entity in question is not an organism, or at least not an organism of the required type—just as my lack of wings means that I am not an avian organism. It might also mean, however, that the entity in question is an organism, and an organism of the required type, but one that is defective, perhaps even severely defective. The crucial point is that telling the difference between these two ways of understanding the absence of the right genetic structure requires doing more than pointing out that such an absence has occurred.

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third or fourth day of his existence. Even so, it is difficult to see how these new conditions could alter in any essential way the fact that Mike would still have been a human organism for at least the first three or four days of his existence. This is because the decisive question regarding Mike's status as a human organism is not whether he is unable, or designed to be unable, to keep surviving as a human organism after a certain point, but whether he came into being as a member of the class of human organisms, to which nature "owes," *de jure*, a certain survival capacity. If this should be the case, then no genetically programmed delayed structural collapse, however massive and however early, can revoke Mike's ontological status as a human organism, but can only modify and mask its normal developmental expression. So long as Mike is constituted in the way human organisms are, then he is one, and so is by essence the sort of thing that ought to be able to do all the things that proponents of ANT would require him to do to count as a human organism, even if, *de facto*, he is unable to oblige.

[40]This would be true even if the new entity underwent its pre-destined delayed structural collapse with no visible delay, already at the very first moment of its existence. Of course, there is something paradoxical about the idea of an entity coming into existence already dead. Perhaps we can unravel the paradox into the following alternative. Either the new entity comes into being and dies very shortly after that, or else it never comes into being. But the only way for it never to come into being is for no fusion of male and female gametes—or the artificial equivalent thereof—ever to precede its appearance. Since ANT does not realize this condition, for the reasons given in Section One, then we have to conclude that it is the cloning of a severely defective human being.

We have to take the further step of comparing the absence of the right genetic structure to the entity's origin, which alone will tell us—this is the implication of Spaemann's Principle—whether the entity's natural teleology was not to be an organism, or was, and has simply suffered some defect, however crippling.

If proponents of ANT are going to maintain that the procedure does not create human monsters, they will have to do more than adduce the ANT product's *ab initio* lack of certain genes. They will have to show, on the basis of how the new entity is constituted, that its natural teleology was never to be, and to be able to survive as, an organism *de jure*—especially since, unlike our hypothetical conceptus, the ANT product would have to be able to live, not just for a few seconds, but for at least three or four days, and in the meantime would behave for all the world like a *bona fide* human organism.

Given Spaemann's Principle, however, there is only one way in which ANT could actually produce the sub-organismic entity the procedure's proponents claim it will: by literally changing the essential genomic structure of the donor cell prior to its transfer into the enucleated egg cell from human to non-human. Such an essential change would require much more than engineering the functional absence of certain developmentally crucial genes *ab initio* in the new entity. It would require nothing less than a kind of metaphysical surgery capable of making the new entity's genetic structure be that appropriate to a type or species of entity that is non-human in character. But—and here we return to the argument laid out in Section Two—even if such metaphysical surgery were possible, ANT's conceptual parameters rule it out. Given that ANT relies on human SCNT, in fact, the substantially intact human genome we have to find at the end of the process for it to be judged a success will also have to be present at its beginning, which is to say, in the donor cell about to be transferred into the enucleated oocyte. But SCNT using a donor cell with a substantially intact human genome is human cloning. Given the conceptual parameters of ANT, then, the genetic engineering it would undertake cannot be as radical as proponents claim, that is, it cannot actually reduce the new entity to a sub-organismic artifact. ANT, for all of its proponents' claims that the procedure would create genomically human, but sub-organismic entities through genetically modified SCNT, remains the cloning of human monsters.

Of course, proponents of ANT will allege that genetic engineering performed, say, prior to the transfer of the somatic cell nucleus, would ensure that the new entity would never be *meant* to be an organism. The problem with this response, however, is that "meant" is ambiguous. It is one thing for us to pre-program the new entity to lack the genetic platform on which to establish the coordinated all-at-onceness of its essential parts, and so to suffer delayed structural collapse sooner or later. It is quite another thing, however, to claim to have thereby broken the essential connection between the constitution of a new human genome—or the artificial equivalent of that constitution—and the initiation of a new human organismal life. To be able to make this claim in all truth would require, as I just noted, a kind of metaphysical surgery that genetic engineering is probably incapable of performing in principle. But even if such metaphysical surgery were within our reach, it would be incompatible with the conceptual structure of ANT, which requires an essential genomic continuity between the embryonic stem cells to be obtained at the end of the procedure and the donor cell nucleus with which the procedure initiates—which, as we have seen numerous times, makes the procedure technically and morally equivalent to human cloning. Only a confusion between a pre-programmed genetic defect and the literal creation of a biological artifact (the natural teleology of which is not to be a human organism), between the manifestation of organismal traits and the possession of organismal being, could lead proponents of ANT to overlook this implication of the procedure's conceptual structure and to place such an exaggerated confidence in the power of biotechnology to re-engineer anthropogenesis.

IV. Mechanism Redivivus

The burden of the foregoing argument has been that the proposal of ANT contains an inner contradiction. So long as ANT both uses human SCNT *and* aims to make available fully functional human embryonic stem cells, the procedure's conceptual structure is incompatible with the claim that it would create a genomically human, but sub-organismic biological entity. Given that ANT relies on human SCNT techniques, what it brings into being cannot be genomically human without also being organismically human, and no amount of *ante ovum* genetic engineering can alter this fact, at

least not without leaving ANT inapt to fulfill the purpose for which it has been conceived. No matter how much genetic engineering it employs, if ANT is going to procure functional human embryonic stem cells, it can do so only at the price of bringing into being—by human cloning—defective human organisms.

Another thing that our argument so far has made clear is that proponents of ANT exaggerate or inflate the power of genetic engineering to re-design the anthropogenetic process, so as to make it yield, not the new human organism we would expect, but a sub-organismic, tissue-like biological artifact. I have already explained how the conceptual structure of ANT makes untrue this sweeping claim—the claim that "[w]ith new tools from cytology to synthetic biology, we are gaining control of not just component parts and their partial trajectories of growth, but the very principles and dynamics of organismal systems"—and that the reality underneath the claim is actually much more modest.[41] But, presuming good faith, as we must, why do proponents of ANT not see through the inflationary nature of their own rhetoric? The answer, which brings us back to the starting-point of the essay, is mechanism. Proponents of ANT miss the conceptual flaw in their proposal, and speak confidently about constructing partial subsystems detached from the organismic wholes in which these subsystems naturally occur, because, despite their protestations to the contrary, they are mechanists who believe that living organisms are actually just complex machines: assemblages of parts whose unity is entirely a result of their completed assembly, and is in no sense "more than

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[41]The citation is from Hurlbut, "Altered Nuclear Transfer," 7. Admittedly, there is a sense in which it is possible to control anthropogenesis, and even to progress open-endedly in our mastery over it. But such mastery always concerns the details of the anthropogenetic event, and can never really alter its essential nature. The proposal of ANT blurs this distinction between the essence and the details of anthropogenesis. Necessarily so, because, for ANT to be morally acceptable, it has to be true that the manipulation of some details of anthropogenesis through selective genetic engineering is sufficient to change its essence from the origination of a human being to the origination of parts of a human being detached from the whole, of "subsystems" severed from "their full natural organismal context" (ibid., 8). The problem, of course, is that ANT cannot really do this without frustrating the goal for which it is conceived: the procurement of functional human embryonic stem cells.

the sum of its parts."[42] We have already encountered an eloquent expression of this mechanism:

> The resulting cells would have no inherent principle of unity, no coherent drive in the direction of the mature human form, and no claim on the moral status due to a developing human life. Rather, such a partial, disorganized organic potential would more rightly be designated *a biological "artifact"—a human creation for human ends*. The fact that some part of such a constructed entity will carry a certain momentum of development is analogous to the fact that we can grow skin in a tissue culture and may one day grow whole organs or limbs in isolation. Lacking crucial elements of its fundamental constitution, such an entity could never rise to the level of a living being.[43]

Admittedly, proponents of ANT, unlike classical mechanists, emphasize what might be called the "irreducible complexity" of organisms, underscoring that organisms are the organisms they are by maintaining the coordinated all-at-onceness of their essential parts. Nevertheless, the notion of irreducible complexity, of the coordinated all-at-onceness of essential parts, is by itself not sufficient to guard against mechanism. I borrow the term "irreducible complexity" from Michael Behe and other exponents of the Intelligent Design movement. I do so because I find that it captures precisely the subtly mechanistic understanding of organism

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[42]It is an old adage that "the whole is more than the sum of its parts." This phrase has the ring of a shopworn cliche, and so may seem out of place in a serious philosophical analysis. Nevertheless, it contains an important truth. The unity of the whole (and here, remember, we are thinking about the whole that is the living organism), while realized only in an organized collection of parts, is not itself a part, or, indeed, anything part-like. For this reason, it cannot be discovered by itemizing the parts, but only by seeing them all together. But "seeing them all together" does *not* mean "itemizing them, only all at once." It means, rather, noticing how they subserve, in coordination, a *telos* that they, the parts, are not, either singly or collectively. But this *telos*, for the very same reason, has to precede the parts ontologically, even as it is simultaneous with them chronologically. It is this ontological priority that makes the whole more than the sum of its parts, meaning: not simply the result of their being all together in the right way, but also the cause of their being all together in the right way. In what follows, I hope to show that the proposal of ANT focuses on the chronological simultaneity of the unity of the whole with the parts, to the neglect of the ontological priority of the former over the latter.

[43]Hurlbut, "Altered Nuclear Transfer," 10; emphasis added.

underlying ANT. Intelligent Design, while rightly emphasizing that living organisms are organized systems of interlocking parts, nonetheless interprets this organized systematicity as if living organisms were complex machines: too complex to have arisen by chance, to be sure, but machines nonetheless. I do not deny, of course, that irreducible complexity is a feature of living organisms. The point is rather that, taken by itself, it does not express the kind of unity proper to living things—to natural entities—as opposed to artificial ones. After all, all of the essential parts of computers, lawnmowers, and televisions have to be working at once for the machines themselves to work, but they are just that, machines, and no amount of coordinated all-at-onceness of essential parts can change that fact.

In order to discriminate between the living organism and the machine, then, we cannot simply appeal to the organism's maintenance of the coordinated all-at-onceness of its essential parts. We must take account of the fact that *the principle* by which it performs this maintenance is different from the principle by which a machine might do so. The difference can be seen in a crucial and distinctive feature of living organisms that machines lack: the unity of a living organism, from whence its self-maintaining activity proceeds, not only depends on the coordinated all-at-onceness of its essential parts, but also precedes it in some sense. Schematizing, we can say that there is a distinction between (i) X's unity depending on the coordinated all-at-onceness of its essential parts *synchronically*, on the one hand, and (ii) the coordinated all-at-onceness of X's essential parts depending *ontologically* on X's unity, on the other—and that organisms realize (i) and (ii), while machines realize only (i). Note that this distinction, on reflection, turns out to be between a necessary condition for X's survival at any given moment (X's synchronous dependence on its parts), on the one hand, and a sufficient condition of X's essentially being the sort of thing X is, on the other. Our distinction proves, in other words, to correspond to, and provide a philosophical foundation for, the *de facto* and the essential senses in which X may be said to meet the criteria for organismal being.

Let us illustrate this crucial difference between organisms and machines by comparing a lawn mower and embryonic Mike from our earlier example. The unity of the lawn mower clearly depends synchronically on the coordinated all-at-onceness of its essential parts. After all, a lawn mower just *is* a certain arrangement

of parts brought together to accomplish a certain purpose. Notice, however, that the unity of the lawnmower does not ontologically precede the coordinated all-at-onceness of the mower's essential parts, at least not in a sense sufficiently strong enough to make it count as an organism. True, the design of the lawn mower pre-exists the actual machine fully formed—but only in the designer's head, and not "in" the lawn mower itself. It is not the lawn mower that assembles itself according to a blueprint that it itself possesses within itself. Rather, it is the designer who pieces it together according to a blueprint that he, and not the mower, possesses within *him*self. Things are very different in the case of embryonic Mike, however. He, like the mower, also depends synchronically on the coordinated all-at-onceness of his essential parts: at any given moment, embryonic Mike survives because all the right parts are there all at once. Differently from the case of the mower, however, the coordinated all-at-onceness of embryonic Mike's essential parts also depends ontologically on embryonic Mike himself. This is because, in contrast to the mower (as opposed to its idea) that is fully present only at the end of a piece-by-piece assembly, embryonic Mike himself is fully present from the first moment of his existence. So much so that Mike himself will grow or unfold *out of himself* the essential parts that he will need to survive at any given moment of his existence thereafter. And he will unfold his essential parts, not one-by-one, but in successive synchronic configurations characterized by coordinated all-at-onceness.[44] By the same token,

[44]In order for Mike to keep himself in existence from moment to moment, he has to master the synchronic coordination of his essential parts from moment to moment. If Mike is still developing in the womb, this will mean that he has to provide himself with a progressively more differentiated synchronic coordination from moment to moment. But, since he is the one mastering the synchronic coordination of his essential parts, it must be the case that he gives himself the particular stage of this coordination he needs at a particular time *all at once*. We see this fact confirmed in the amazing phenomenon that, in embryogenesis, the various components of the growing being always seem to be cooperating as if they all "knew" what to do all at once, as if they were all converging spontaneously upon a shared project (here is the truth, by the way, in the notion of self-organization from below not controlled by some locally isolable command center: there is a center, but it is everywhere at once, and each part shares in it in relation to all the others). Of course, in order to get himself from synchronic configuration X to synchronic configuration Y, embryonic Mike also has to develop certain parts in stage X that will enable him to make the transition to stage Y. There is thus an element of linear causality in the embryogenetic process that cannot be denied or

the coordinated all-at-onceness of embryonic Mike's essential parts, while synchronically a condition of the possibility of his continued survival from moment to moment, is also always a function, ontologically, of his already existing fully human, fully organismic unity.

Returning to the matter at hand, then, I contend that the proposal of ANT ignores the distinction between organism X's synchronic dependence on the coordinated all-at-onceness of its parts, on the one hand, and the latter's ontological dependence on X, on the other. It thus treats the organism as if its unity were simply the function of the coordinated all-at-onceness of its essential parts, and so attributes what is in essence a machine-like, rather than an organismic, quality to that coordinated all-at-onceness itself. Let us see how this is so.

If the proposal of ANT were simply to cultivate parts in isolation from the whole, I would be more hesitant to charge it with mechanism. If I do accuse ANT of mechanism, it is rather because it seeks to change the nature of the whole itself. That is, ANT is conceived within the limits of existing techniques of SCNT, which, in the "normal" case, if we can use such language, mimics the event in which a new whole—a new human organism—is first constituted. ANT proponents' claim, of course, is that genetic engineering, performed *ante ovum*, will ensure that the new entity comes into being with an innate insufficiency, present *ab initio*, to be such a human organism, which is to say, such a complete living whole. But that is just the point: the proposal of ANT banks on the possibility, not just of growing parts in isolation from a whole, as it would if it were, say, to try to coax embryonic stem cells to grow into a leg, but of remaking the event in which a new human whole is constituted into an event in which only a part of that whole is constituted.

ANT is supposed to grow something more than just isolated organs or limbs: partial developmental *trajectories*, which overlap with those of embryos up to the point where the inner cell mass forms and so embryonic stem cells become available. But unless proponents of ANT can figure out a way of literally assembling such a partial developmental path piece-by-piece, then the only

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underestimated in importance. But this linearity is always (also) subordinate to a more encompassing holistic, over-all-at-once sort of causality.

way for them or for anyone else to get one is to bring into being an entity capable of developing *itself* in the necessary way up to the desired point. An entity, then, that does everything an embryo does for at least the first three or four days of its existence. And since this entity is able to yield functional human embryonic stem cells, and if it was created by some form of SCNT using a genomically human donor cell, then it is hard to see how it is not an embryo after all, albeit one with life-threatening genetic defects. But this implies, conversely, that proponents of ANT could be correct in thinking that the product of the procedure is not an embryo only if it were possible to construct a partial embryonic developmental path in piece-by-piece fashion, which is to say, only if . . . the unity of living organismic wholes could be assembled, disassembled, and reassembled at will—presuming, of course, that "[w]ith new tools from cytology to synthetic biology, we are gaining control of not just component parts and their partial trajectories of growth, but the very principles and dynamics of organismal systems."[45] But this could be the case, in turn, only if the unity of living organisms never ontologically preceded the coordinated all-at-onceness of their essential parts, but always merely followed it. Hence the Q.E.D. that was the aim of my argument in this essay: proponents of ANT fail to grasp the implications of their proposal—that, namely, it would bring into being human organisms after all—because they assume a (subtle) mechanistic mereology that gives no ontological priority of wholes over parts in living organisms.

Conclusion

ANT is explicitly proposed as a "technological solution to our moral impasse."[46] Concretely, this means an *immediate* way forward to overcome our political deadlock, "immediate" meaning: based on already existing techniques of nuclear transfer, and not on the hoped-for, but not-yet-existing techniques of, say, regression of adult somatic cells to the pluripotent state. Conceptually speaking, then, ANT represents no new fundamental advance over

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[45]Hurlbut, "Altered Nuclear Transfer," 7.

[46]Ibid., 1.

SCNT, and so, by the very nature of the case, cannot claim to bypass the philosophical and moral objections to human cloning. That proponents of ANT can nonetheless claim to have done so reflects an unjustified over-confidence in the power of genetic engineering. Ironically, even if this confidence were justified, it would make no difference, because, as we have amply shown above, the conceptual structure of ANT—here not sufficiently distinguishable from the conceptual structure of cloning—presupposes an essential genomic continuity from beginning to end of the process. As a technological solution to a moral impasse, ANT, like many other such technological solutions, is a quick fix that merely papers over, without actually resolving, the philosophical and moral difficulties attaching to the human SCNT on which it piggy-backs conceptually.[47]

Ironically, however, the fix that ANT offers may not be so quick, after all. SCNT, especially when coupled with genetic engineering, is much more technically difficult, much more labor-intensive, and much less certain a method of obtaining embryonic

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[47]Speaking of quick fixes, it is interesting to note that, alongside confident statements about the power biotechnology has put into our hands, the proposal of ANT offers other statements that, perhaps unintendedly, seem to suggest that the confidence of the first series of statements is unwarranted. Thus, we are told that selective genetic engineering can give us a biological artifact where we would have expected a human organism—but then that we "may *one day* grow whole organs or limbs in isolation" (ibid., 10; emphasis added). Or again, right before we are assured that "we may be able to use the techniques of Nuclear Transfer . . . to construct a biological entity . . . that . . . lacks the attributes and capacities of a human embryo," we find out that "while the ultimate goal for the generation of ES cells is the direct nuclear reprogramming of an adult nucleus, *it may be many years before our scientific knowledge and control of cellular factors will make this approach feasible*" (ibid., 8; emphasis added). These juxtapositions provoke the following question: if we already possess the key to the principles and dynamisms of human biology, why can't we already grow limbs in petri dishes or reprogram adult somatic cell nuclei for pluripotency? If, on the other hand, we cannot accomplish these feats, why are we so confident in our ability to take a process such as SCNT that relies totally on the natural givens of human reproduction and to use that process to "create" something other than a human being? And if we are not entitled to the kind of confidence that proponents of ANT seem to have, what justifies the diversion of time and energy from the effort to elaborate techniques for obtaining embryonic stem cells that bypass nuclear transfer altogether? Is perhaps some extra-scientific urgency—say the need to break the current political deadlock over stem cell research—hindering proponents of ANT from fully recognizing the uncertainty that still surrounds their project?

stem cells than the ones currently in use. From the practical point of view, then, ANT has very little to entice researchers who rely on the current methods to give them up, as the reaction of Douglas Melton et al., which I cited above,[48] and which is likely to be typical, suggests. In the face of the significant practical difficulties ANT entails, the only thing that could induce researchers who have no objection to the destruction of pre-implantation embryos to embrace it as an alternative to the easier-to-use methods they now employ would be moral conviction. But that is just the problem: ANT is supposed to be acceptable, not only to pro-lifers, but also to embryonic stem cell researchers, regardless of their respective moral convictions about the status of pre-implantation human embryos. This reflection confirms the fact that there is no substitute for moral argument, and so for philosophical reasoning, when it comes to dissuading colleagues from research that involves the destruction of embryonic human lives. There can be no technological solution to this moral impasse, only a moral one, and reaching it is going to require, among other things, hard, critical examination of the supposed necessity of procuring human embryonic stem cells for the welfare of science and of mankind on which a good deal of the discussion about embryonic stem cells is based.

This suggests another, related reason why a technological quick fix to the moral impasse over human embryonic stem cell research is inappropriate: a big part of what makes this particular impasse an impasse is precisely the biotechnology of human embryonic stem cell research itself. It is commonplace, of course, to speak of bioethical questions as new issues created by the development of new technologies. But this way of viewing the *enjeu* of bioethical matters is misleading. As Canadian philosopher George Grant has argued, technology is not simply a repertory of value-free techniques that we then must decide to use according to the norms of ethics. Rather, technology is itself the very understanding of technique as value-free, that is, as not intrinsically responsive to any pre-given natural limits on human making.[49] This

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[48]Melton, et al., "Altered Nuclear Transfer in Stem-Cell Research—A Flawed Proposal."

[49]See, above all, Grant's seminal essay "Thinking About Technology," in George Grant, *Technology and Justice* (South Bend: University of Notre Dame Press, 1986), 11–34.

is especially true when it comes to the biotechnology of embryonic stem cell research, which (often with the best motives in the world) undertakes to rewrite the distinction between nature and artifice with respect to anthropogenesis—and so by definition overlooks or discounts nature as a pre-given norm for human making.

Now, I am not accusing the proponents of ANT of explicitly attempting to undermine the natural law, or to erase the distinction between nature and artifice. I am rather pointing out the doubtless unintended drift of the logic of their claims about biotechnological making, which, as I have argued above, could be true only if mechanism were true, hence, if there were no principled distinction between the artificial and the natural. But if there is no principled distinction between the artificial and the natural, then there is no pre-given, natural limit on human making, and ethical considerations come too late to seem like anything more than schoolmarmish hand-wringing lacking the seriousness to match the weight of the scientific investigation of human biology. Thus, by attempting a technological solution to our moral impasse, ANT leaves in place the logic of "if it can be done, it may be done" that gave rise to the impasse in the first place—and not only leaves it in place, but participates in it. Not, of course, by intentionally undermining the commitment to the protection of embryonic human life, but by unintentionally weakening it nonetheless through the claim to solve our moral impasse by re-writing the very nature of anthropogenesis itself. For if we could do that, then we could lay hold of, and control, the inner principle of the dignity of the human being we claim to be upholding—and so would do away with any intrinsic, given-in-the-nature-of-things standard in the name of which to cry "stop" when biotechnology threatens that dignity.

When it comes to biotechnology, and to the question of human embryonic stem cell research in general, no technological quick fix can replace what we need to do instead: reflect, in philosophy's native openness to the whole, on the assumptions and implications underlying such research. It may be that such reflection will lead to the conclusion that experimentation on human embryonic stem cells is not desirable in any conceivable scenario. But we cannot let our apprehension about embracing what might seem to us now such an unthinkable conclusion prevent us from considering the project of human embryonic stem cell research as a whole, and in its deepest and most comprehensive significance, if

for no other reason than that, to be truly intelligent men and women, we must decide what is thinkable and unthinkable only after having stood in steadfast attention to the whole, to borrow another expression from George Grant. To decide what is thinkable and unthinkable before having exercised such attention is to let irrational anxieties lead us to hasty, ideologically foreshortened conclusions and actions unworthy of rational beings. My point in saying this, I hope it is clear by now, is not that we should not try to "play God." We are, after all, God's images, entrusted by him with the creative stewardship of his creation. My point is rather that, if we do not stop— literally stop—to think about biotechnological research on human embryonic stem cells in a truly philosophical, that is, comprehensive and disinterested, way, seeking always to understand how such research fits into the logic of technology, we risk, contrary to what we assume are our good intentions, sharing in the widespread, typically modern denial of the natural law God has written into the very fabric of the physical world—and so of failing in our vocation to administer God's world in his image and likeness.

ADRIAN J. WALKER *is an associate editor of* Communio.